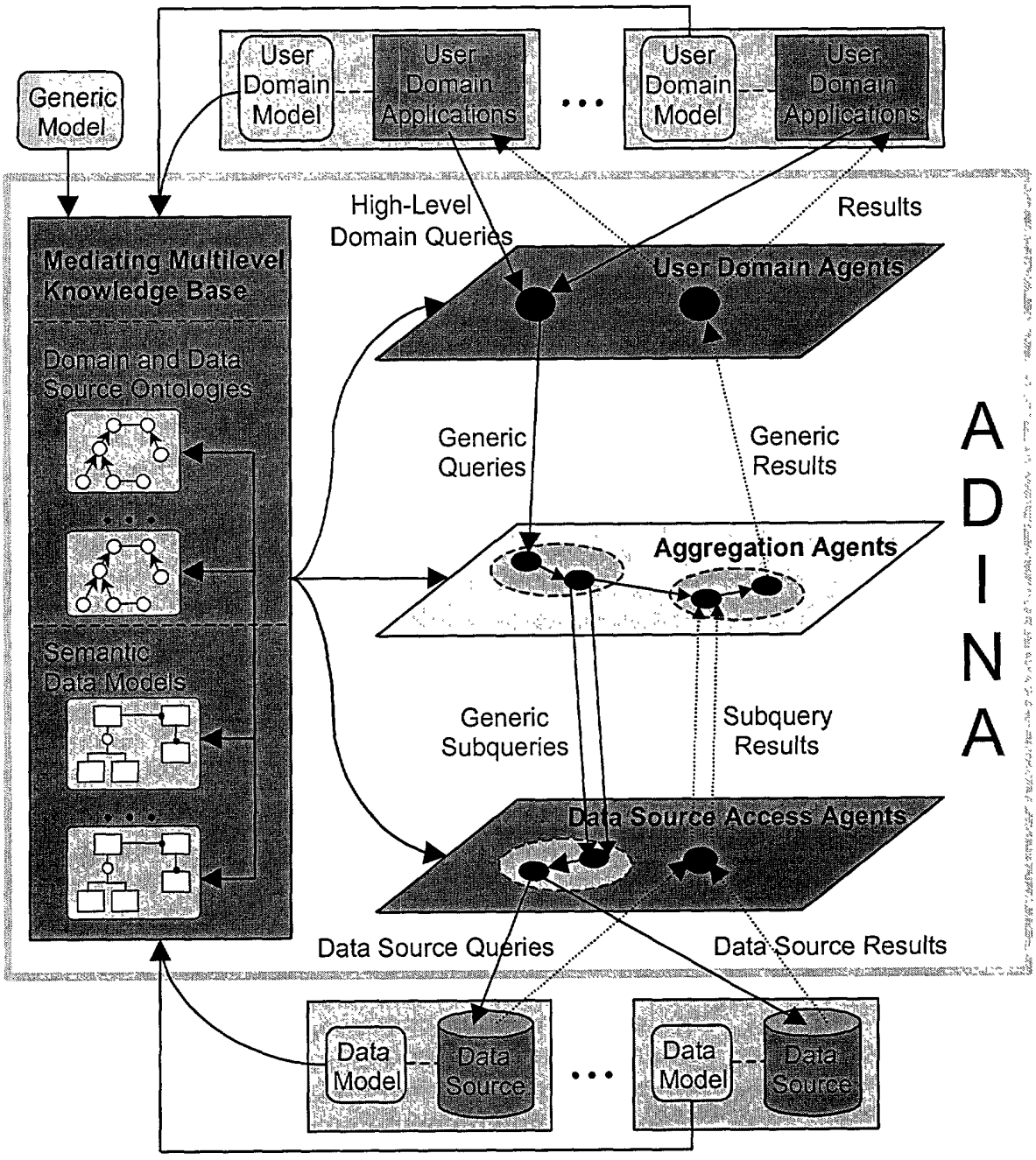

Generic Model
User Domain Model
User Domain Applications
User Domain Model
User Domain Applications
Mediating Multilevel Knowledge Base
Domain and Data Source Ontologies
Semantic Data Models
High-Level Domain Queries
Results
User Domain Agents
Generic Queries
Generic Results
Aggregation Agents
Generic Subqueries
Subquery Results
Data Source Access Agents
Data Source Queries
Data Source Results
ADINA
Data Model
Data Source
Data Model
Data Source

Fig. 1

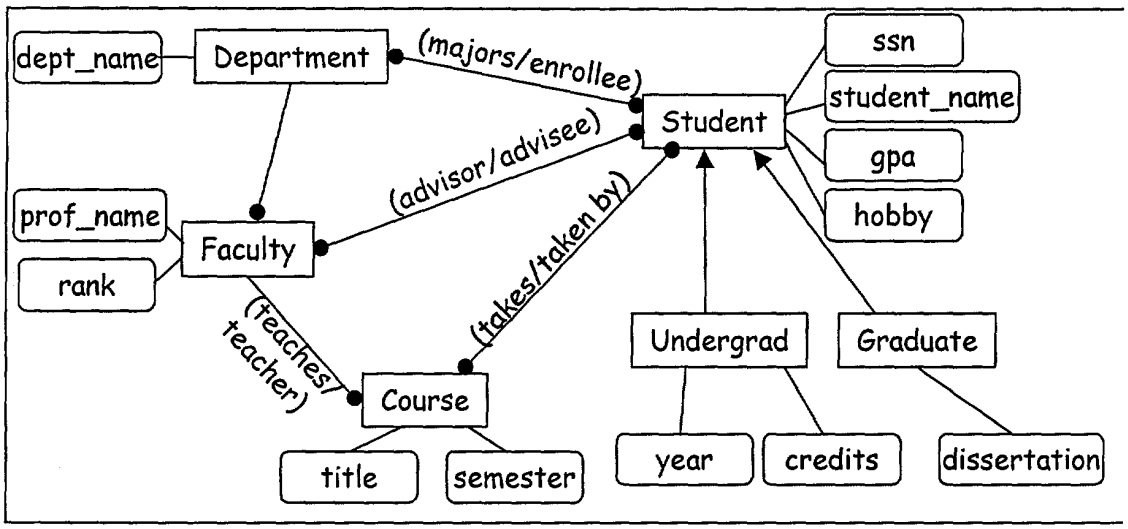


Fig. 2

Advisor to Generic Mappings

1. Φ ($\Pi_{disertation_advisor}$(Advisor)) =>
   $\Pi_{advisor.prof_name}(\sigma_{dissertation <> NULL}$(Generic))
2. Φ ($\Pi_{CS_student}$(Advisor)) =>
   $\Pi_{student_name}(\sigma_{major.dept_name = 'CS'}$(Generic))
3. Φ ($\Pi_{good_student}$(Advisor)) =>
   $\Pi_{student_name}(\sigma_{gpa >= 3.5}$(Generic))
4. Φ ($\Pi_{poor_student}$(Advisor)) =>
   $\Pi_{student_name}(\sigma_{gpa < 2.5}$(Generic))
5. Φ (Π_{prof_rank}(Advisor)) =>
   $\Pi_{rank}(\sigma_{dept_name='CS'}$(Generic))

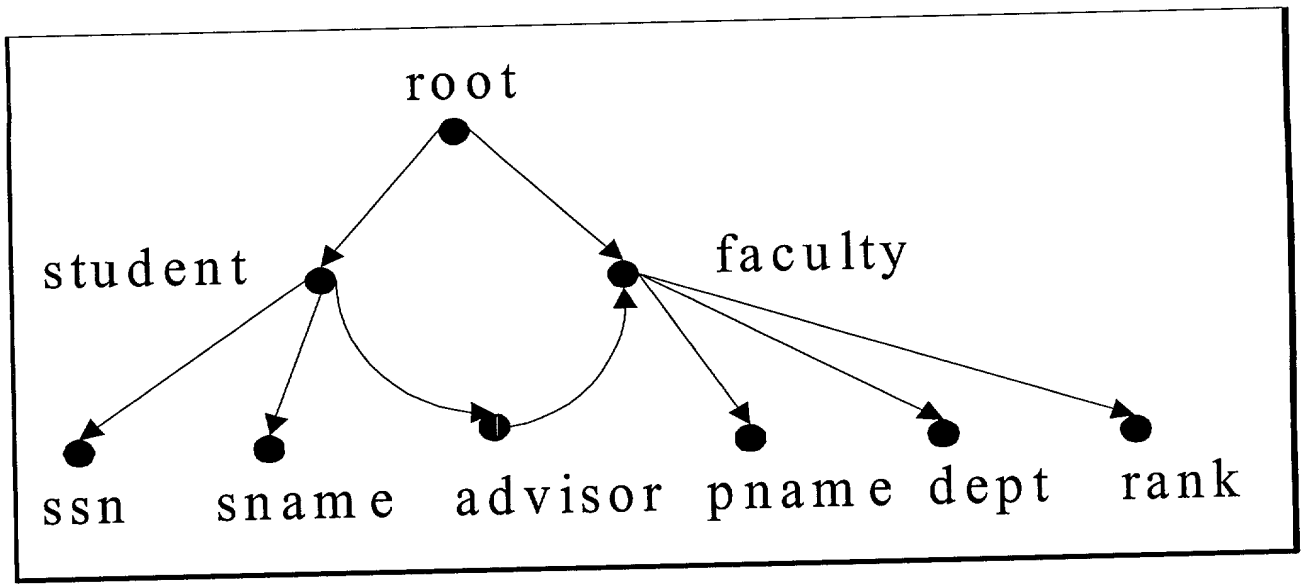
Scheduler to Generic Mappings

6. Φ ($\Pi_{CS_student}$(Scheduler)) =>
   $\Pi_{student_name}(\sigma_{teacher.dept_name = 'CS'}$(Generic))
7. Φ ($\Pi_{good_student}$(Scheduler)) =>
   $\Pi_{student_name}(\sigma_{gpa >= 3.3}$(Generic))
8. Φ ($\Pi_{poor_student}$(Scheduler)) =>
   $\Pi_{student_name}(\sigma_{gpa < 2.0}$(Generic))
9. Φ ($\Pi_{lucky_student}$(Scheduler)) =>
   $\Pi_{student_name}(\sigma_{teacher.rank='Full'}$(Generic))

Figure 3. Inter-Domain Mappings

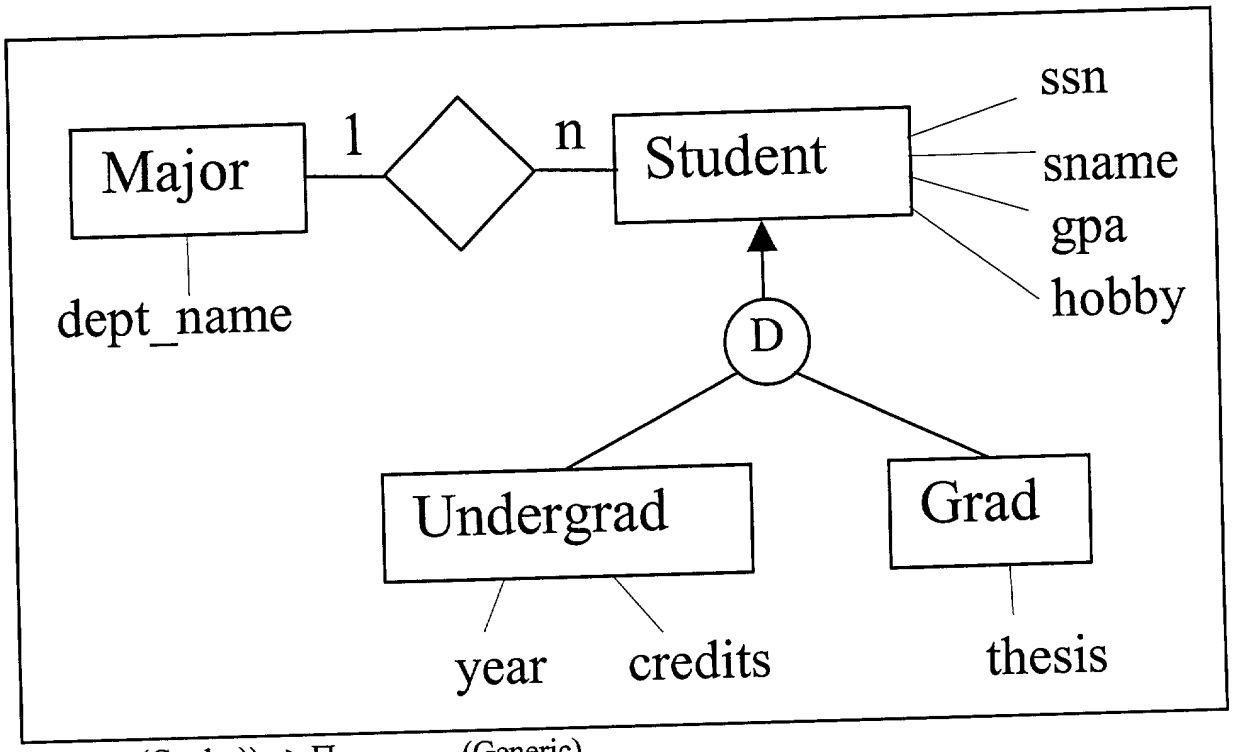
Fig. 3

Doc ID: US 6,934,698 B2



Φ (Π_{sname}(XML)) => $\Pi_{\text{student_name}}$(Generic)
Φ (Π_{dept}(XML)) => $\Pi_{\text{dept_name}}$(Generic)
Φ (Π_{pname}(XML)) => $\Pi_{\text{advisor.prof_name}}$(Generic)

Fig. 4



Φ (Π_{sname}(Grades)) => $\Pi_{\text{student_name}}$(Generic)

Φ (Π_{dept}(Grades)) => $\Pi_{\text{dept_name}}$($\sigma_{\text{major.dept_name='CS'}}$(Generic))

Fig. 5

Document ID: 20030172339

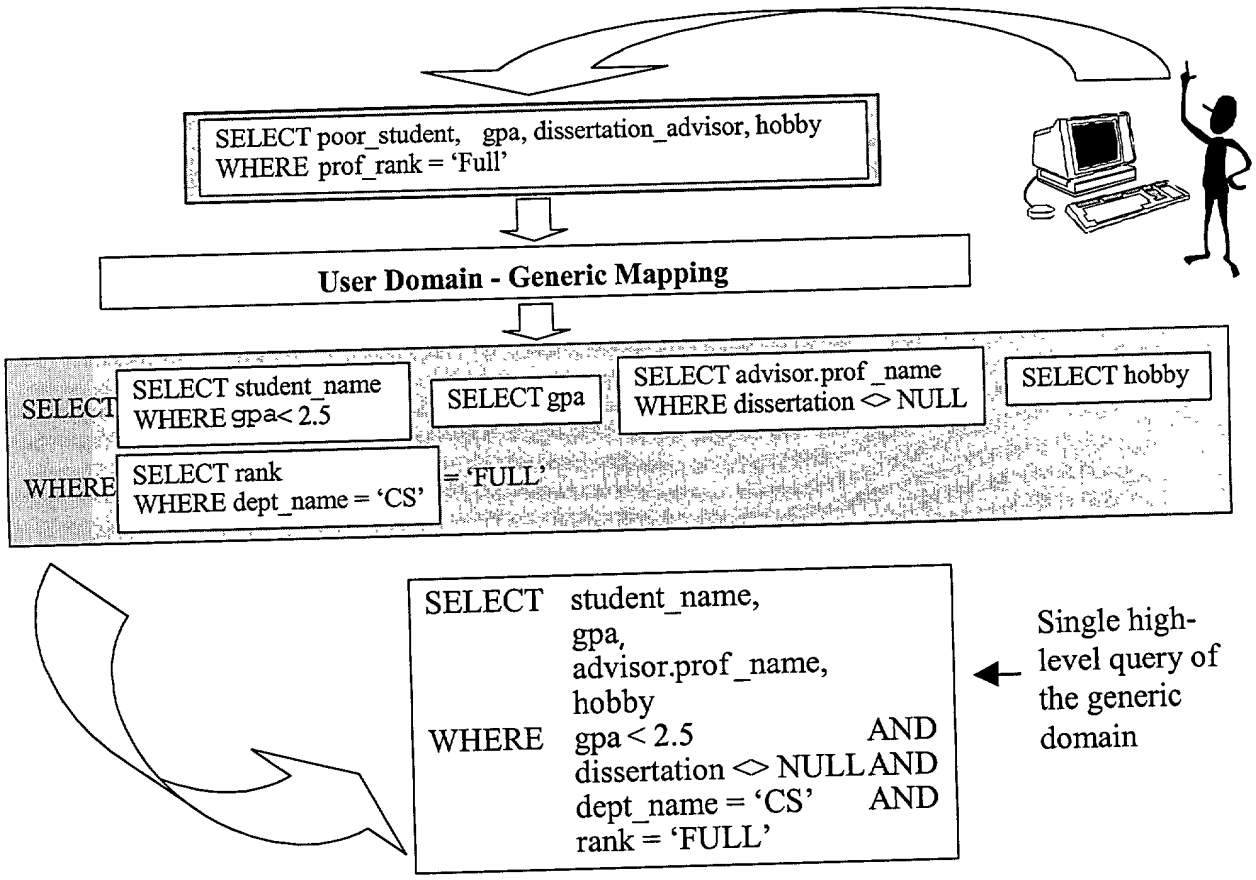

SELECT poor_student, gpa, dissertation_advisor, hobby
WHERE prof_rank = 'Full'
User Domain - Generic Mapping
SELECT
SELECT student_name
WHERE gpa< 2.5
SELECT gpa
SELECT advisor.prof_name
WHERE dissertation <> NULL
SELECT hobby
WHERE
SELECT rank
WHERE dept_name = 'CS'
= 'FULL'
SELECT student_name,
gpa,
advisor.prof_name,
hobby
WHERE gpa < 2.5 AND
dissertation <> NULL AND
dept_name = 'CS' AND
rank = 'FULL'
Single high-level query of the generic domain

Fig. 6

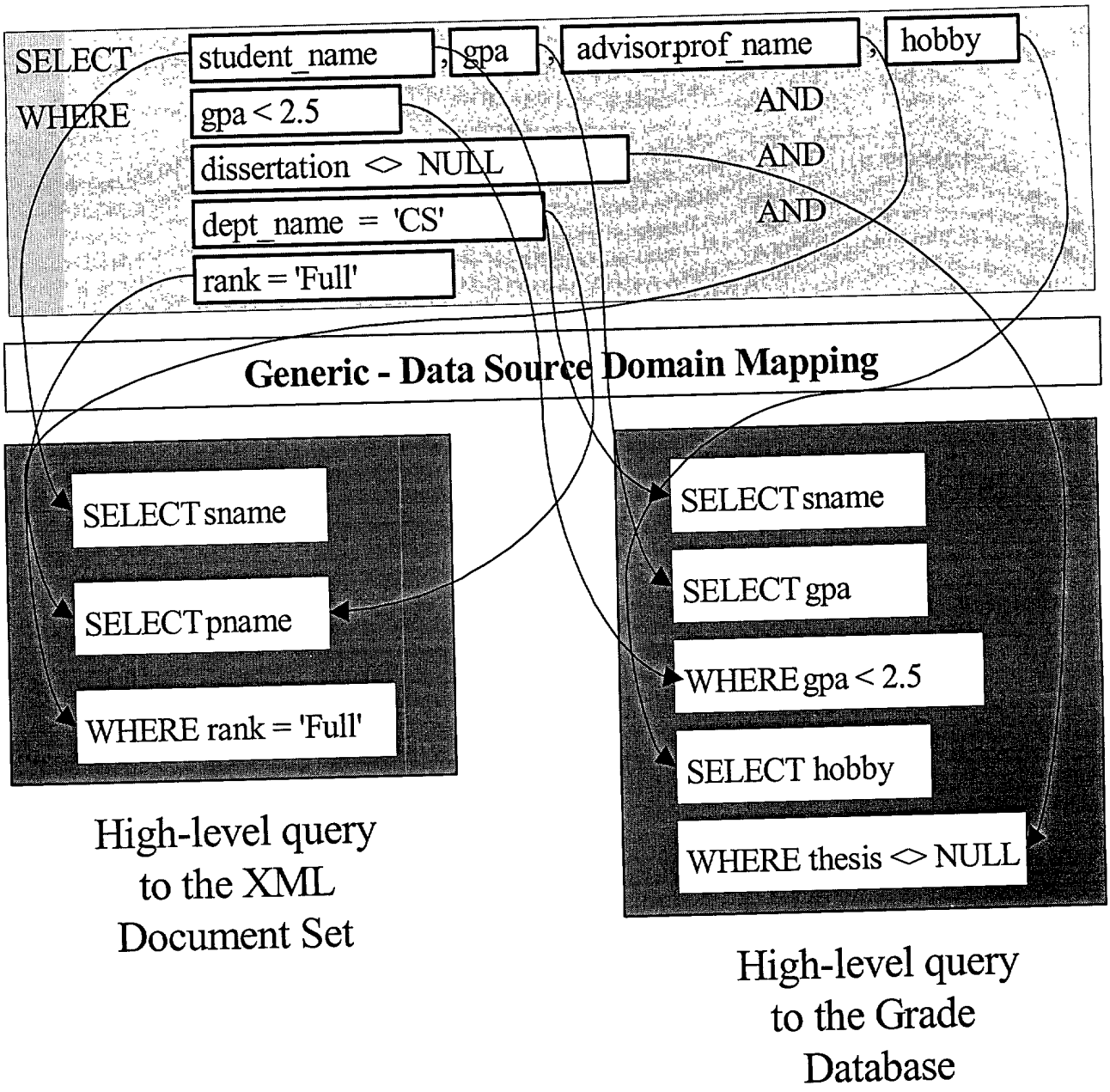

SELECT
student_name
,
gpa
,
advisor.prof_name
,
hobby
WHERE
gpa < 2.5
AND
dissertation <> NULL
AND
dept_name = 'CS'
AND
rank = 'Full'
Generic - Data Source Domain Mapping
SELECT sname
SELECT pname
WHERE rank = 'Full'
SELECT sname
SELECT gpa
WHERE gpa < 2.5
SELECT hobby
WHERE thesis <> NULL
High-level query to the XML Document Set
High-level query to the Grade Database

Fig. 7

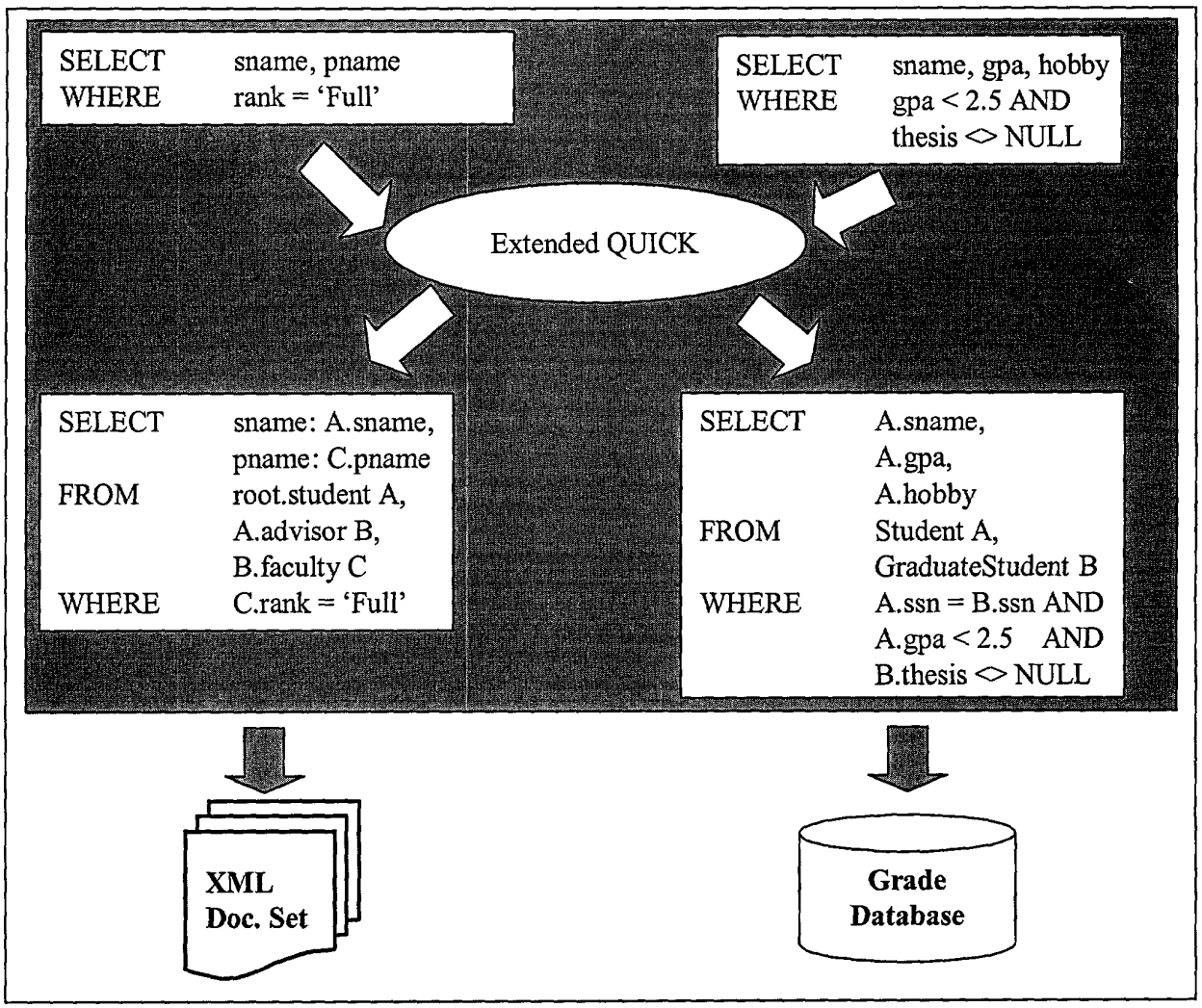

SELECT sname, pname
WHERE rank = 'Full'
SELECT sname, gpa, hobby
WHERE gpa < 2.5 AND
thesis <> NULL
Extended QUICK
SELECT sname: A.sname,
pname: C.pname
FROM root.student A,
A.advisor B,
B.faculty C
WHERE C.rank = 'Full'
SELECT A.sname,
A.gpa,
A.hobby
FROM Student A,
GraduateStudent B
WHERE A.ssn = B.ssn AND
A.gpa < 2.5 AND
B.thesis <> NULL
XML
Doc. Set
Grade
Database

Fig. 8

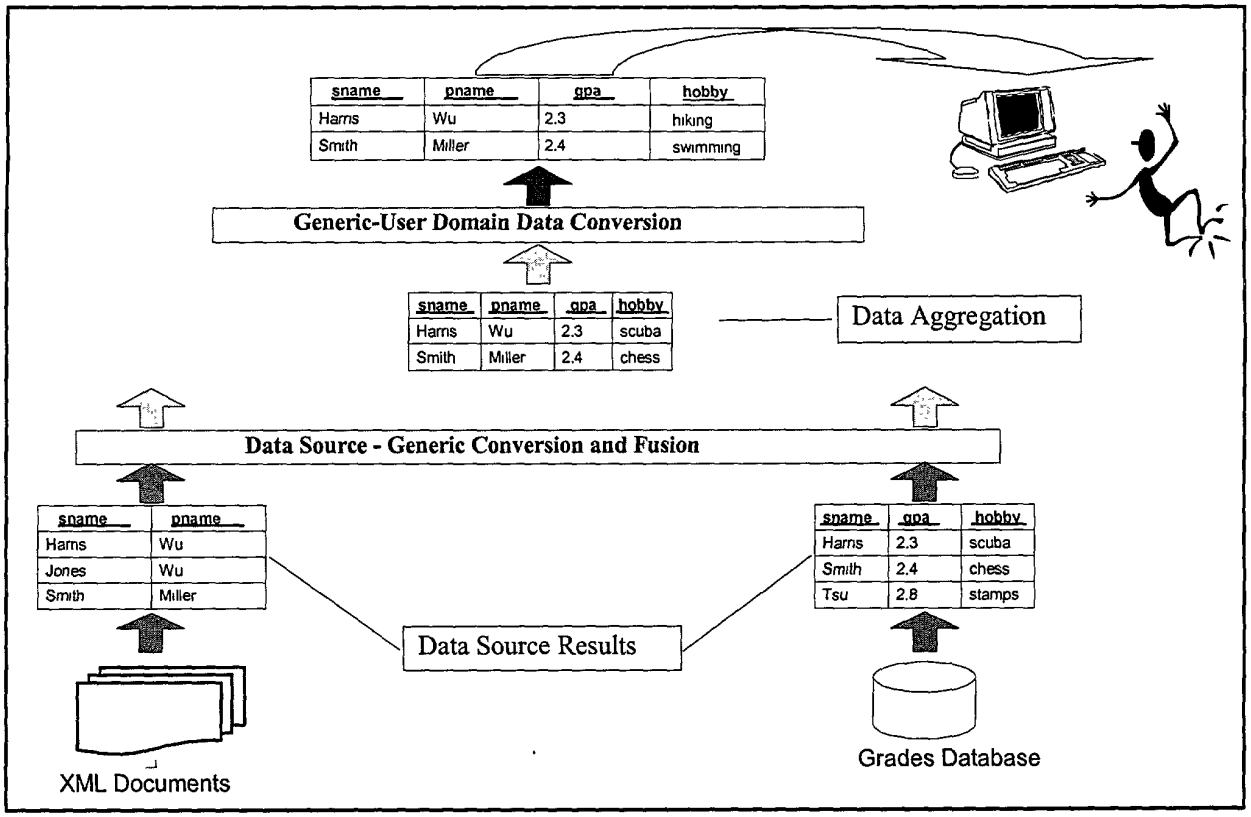

sname pname gpa hobby
Harris Wu 2.3 hiking
Smith Miller 2.4 swimming
Generic-User Domain Data Conversion
sname pname gpa hobby
Harris Wu 2.3 scuba
Smith Miller 2.4 chess
Data Aggregation
Data Source - Generic Conversion and Fusion
sname pname
Harris Wu
Jones Wu
Smith Miller
sname gpa hobby
Harris 2.3 scuba
Smith 2.4 chess
Tsu 2.8 stamps
Data Source Results
XML Documents
Grades Database

Fig. 9

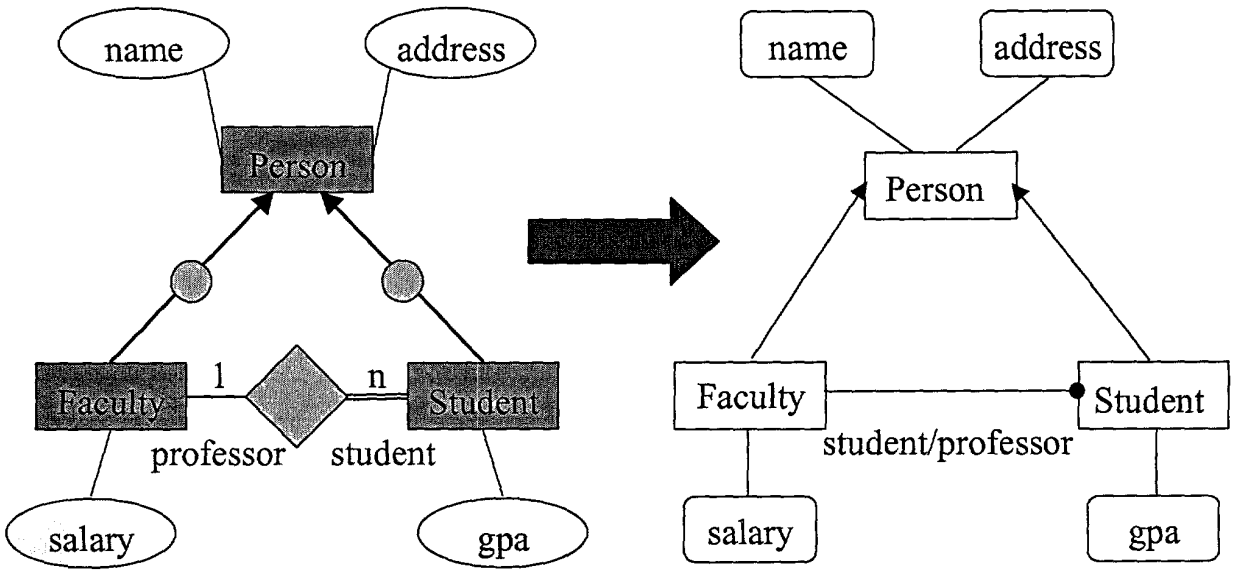

name
address
Person
Faculty
1
n
Student
professor
student
salary
gpa
name
address
Person
Faculty
Student
student/professor
salary
gpa

Fig. 10

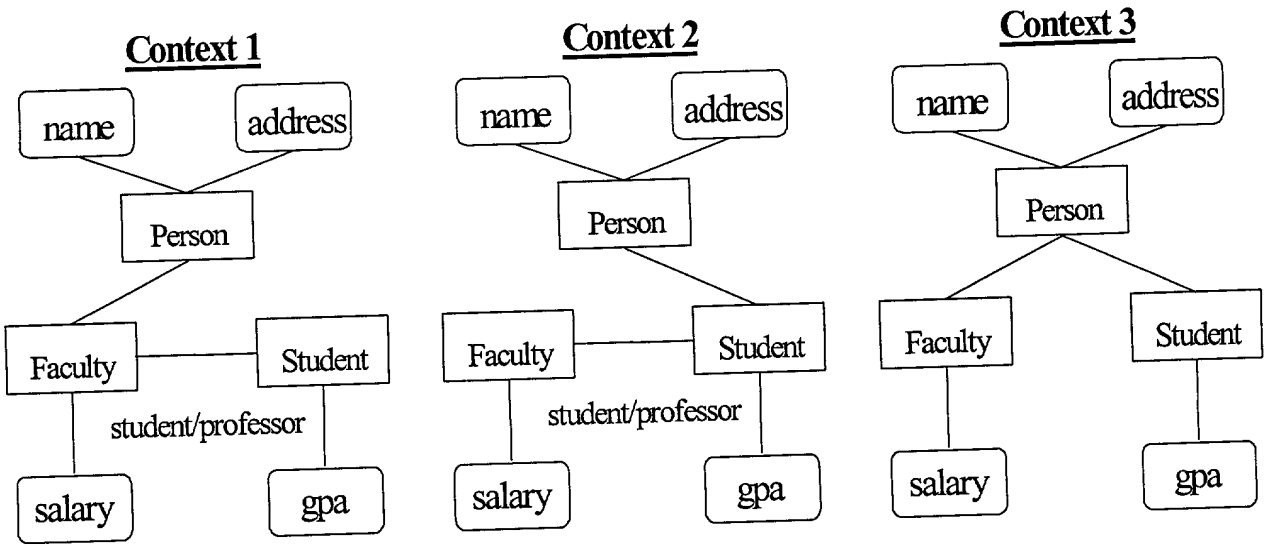
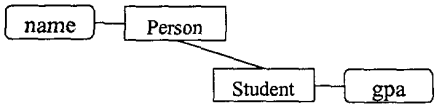

Context 1
name
address
Person
Faculty
Student
student/professor
salary
gpa
Context 2
name
address
Person
Faculty
Student
student/professor
salary
gpa
Context 3
name
address
Person
Faculty
Student
salary
gpa

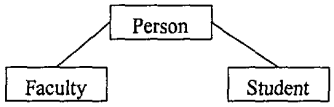
Fig. 11

Context for `student` role (from context 1)



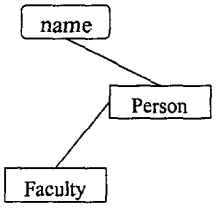

```
SELECT   P1.name
FROM     person AS P1
         NATURAL JOIN student AS S1
           ON P1.name = S1.student_name_fk
WHERE    S1.gpa >= 3.5
```

Context for `professor` role (from context 3)




```
FROM     faculty AS F1
         NATURAL JOIN person AS P2
           ON P2.name = F1.faculty_name_fk
         NATURAL JOIN student AS S2
           ON P2.name = S2.student_name_fk
```

Context for `professor's professor` role (from context 2)




```
SELECT   P3.name
FROM     faculty AS F2
         NATURAL JOIN person as P3
           ON P3.name = F2.faculty_name_fk
```

Bridge between `student` and `professor` roles

```
FROM     student AS S1                          // from student role
         RIGHT OUTER JOIN faculty AS F1         // from professor role
           ON S1.student_professor_name_fk =    // bridge
                        F1.faculty_name_fk
```

Bridge between `professor` and `professor's professor` roles

```
FROM     student AS S2                    // from professor role
         RIGHT OUTER JOIN faculty AS F2   // from professor's professor role
           ON S2.student_professor_name_fk =    // bridge
                        F2.faculty_name_fk
```

Figure 12. Contexts and Query Fragments

Fig. 12

Docket No. 2003P02202US

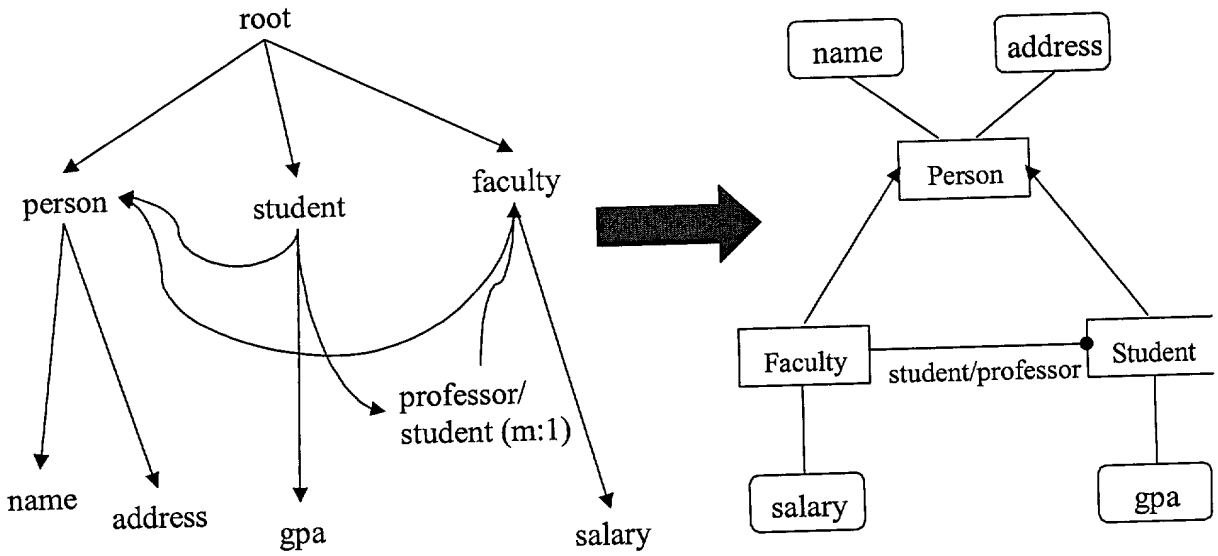

root
person
student
faculty
professor/
student (m:1)
name
address
gpa
salary
name
address
Person
Faculty
student/professor
Student
salary
gpa

Fig. 13

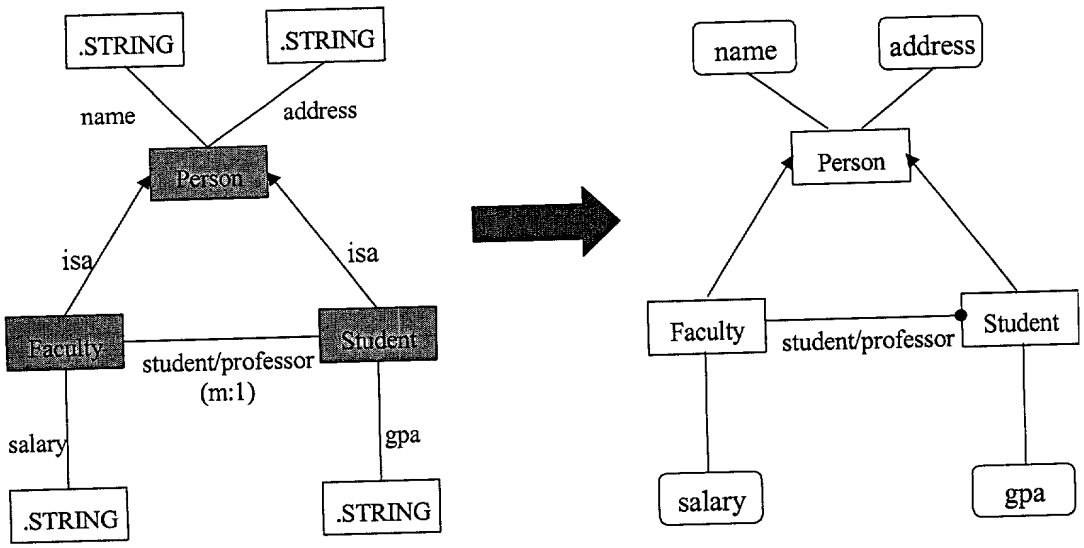

.STRING
.STRING
name
address
Person
isa
isa
Faculty
student/professor
(m:1)
Student
salary
gpa
.STRING
.STRING
name
address
Person
Faculty
student/professor
Student
salary
gpa

Fig. 14

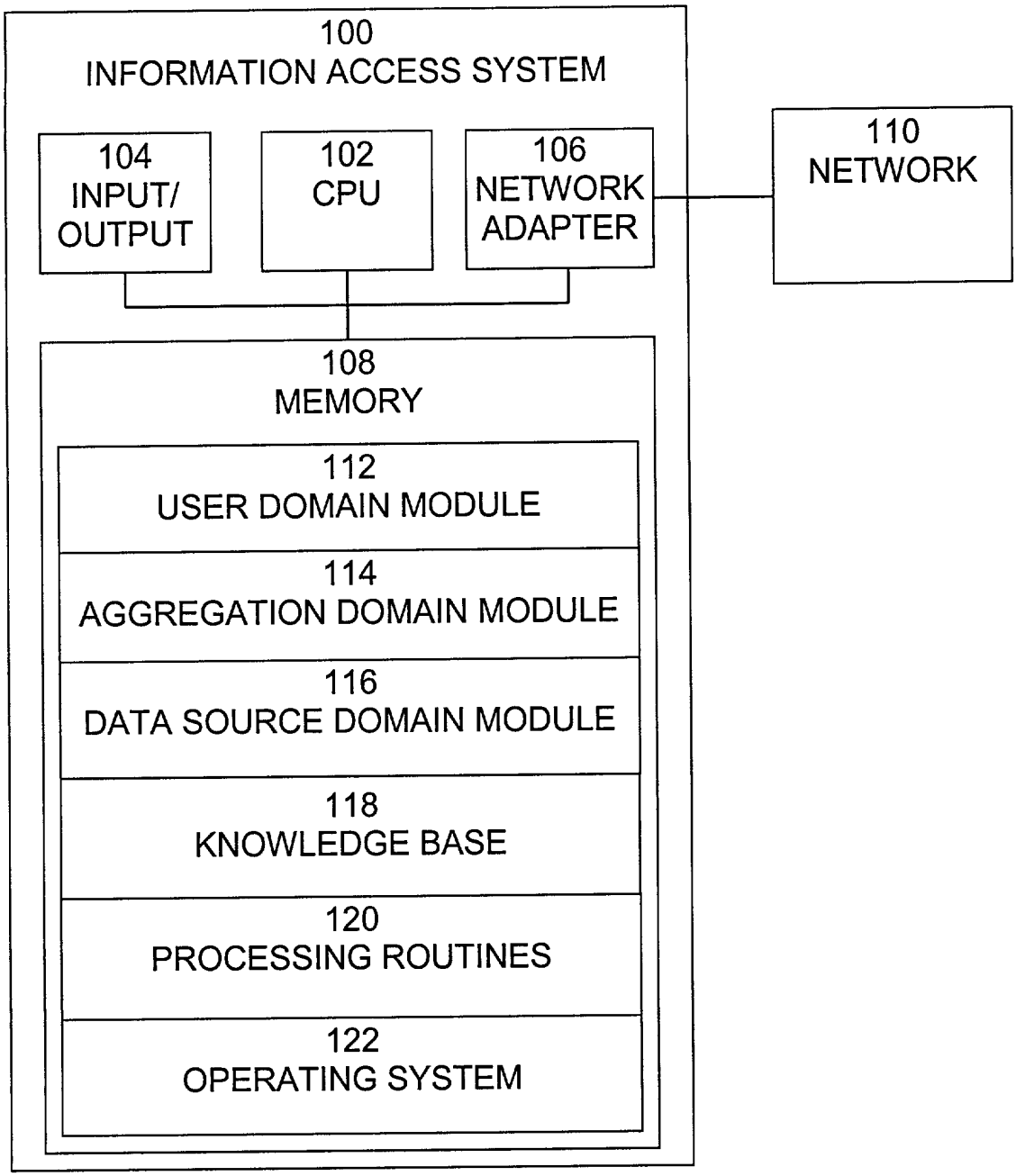

100
INFORMATION ACCESS SYSTEM
104
INPUT/
OUTPUT
102
CPU
106
NETWORK
ADAPTER
110
NETWORK
108
MEMORY
112
USER DOMAIN MODULE
114
AGGREGATION DOMAIN MODULE
116
DATA SOURCE DOMAIN MODULE
118
KNOWLEDGE BASE
120
PROCESSING ROUTINES
122
OPERATING SYSTEM

Fig. 15